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Water Quality of the Fox River and Four Tributaries in Green Lake County, Wisconsin, 2001–2002

Prepared in cooperation with Green Lake County

Open-File Report 03–127

U.S. Department of the Interior
U.S. Geological Survey

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Middleton, Wisconsin: 2003

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Introduction

The purpose of this report is to summarize the water-quality data collected on the Fox River and its tributaries in Green Lake County, Wisconsin, from November 2001 through August 2002. The goals of the project were to (1) determine the current water quality of the Fox River and selected main tributaries in Green Lake County, (2) assess the spacial variation of the water-quality conditions of the main Fox River reach, and (3) build on the quantitative data base so that future monitoring can help detect and evaluate improving or declining water-quality conditions objectively.

Methods

Figure 1 shows locations of the seven monitoring sites in the county and table 1 lists the drainage areas and sampling frequency of each site. Three monitoring sites were selected on the main stem of the Fox River. The most upstream site was located near the Green Lake and Marquette County boundary just upstream of the inlet to Puckaway Lake (fig. 1). The middle site on the Fox River was at Princeton, downstream from the outlet of Puckaway Lake. The most downstream site was at the long-term U.S. Geological Survey gaging station that is upstream from the City of Berlin where the Fox River flows out of Green Lake County.

Four additional sampling sites were established on the principal tributaries near their confluence with the Fox River (fig. 1). The tributaries sampled were the Mecan, White, and Puchyan Rivers and Sucker Creek. The drainage areas and sampling schedules for these sites are given in table 1.

Table 1. Drainage areas and sampling frequency of the seven Green Lake County, Wis., sampling sites

Site	USGS station number	Drainage area (mi^2)	Sampling frequency Nov. 2001 to Aug. 2002
Fox River above Puckaway Lake	04073140	787	6 times; approximately bimonthly
Mecan River near Princeton	04073345	145	2 times; once at high flow and once at low flow
Fox River at Princeton	04073365	962	6 times; approximately bimonthly
White River near Princeton	04073440	131	2 times; once at high flow and once at low flow
Sucker Creek near Berlin	04073450	20.6	2 times; once at high flow and once at low flow
Puchyan River at Highway J	040734745	130	2 times; once at high flow and once at low flow
Fox River at Berlin	04073500	1,340	6 times; approximately bimonthly

The three main stem sites were sampled 6 times in water year 2002 (October 2001 to September 2002). Samples were collected in November, January, March, May, June, and August. The four tributary sites were sampled twice. One sample was collected during a high-flow period (June) and one sample during a low-flow period (August). Stream temperature, pH, turbidity, dissolved oxygen (DO) and conductivity were measured at each site using a multiparameter data sonde. Stream discharge was determined at each site by a current meter measurement (Rantz and others, 1982) or by using the stage/discharge relation at the two continuous-recording gaging stations on the Fox River (Princeton and Berlin).

Water samples collected at each site were analyzed for total phosphorus, dissolved phosphorus, nitrite plus nitrate, total Kjeldahl nitrogen, ammonia nitrogen, suspended solids, suspended sediment, and fecal coliform bacteria. Samples were collected by the equal-width-increment (EWI) method using a handheld DH-59 depth-integrating sampler (Edwards and Glysson, 1999) and composited in a churn splitter for splitting into the appropriate bottles for laboratory analysis. Fecal coliform samples were collected by dipping an autoclaved sterile bottle at the center of the sampling cross section. Water samples were chilled and shipped to the Wisconsin State Laboratory of Hygiene for analysis, except for the suspended sediment samples which were sent to the U.S. Geological Survey sediment laboratory in Iowa City, Iowa.

Results

A summary of all collected data is given in table 2. These data were also published in the USGS annual data report series “Water Resources Data—Wisconsin, Water Year 2002” (Waschbusch and others, 2003). Median values were calculated for the three Fox River sites where a sufficient number of samples were collected. Noteworthy are the very low dissolved oxygen concentrations observed during the runoff event on June 25, 2002 for the Mecan River, White River, and Sucker Creek tributaries, and the Fox River at Berlin.

Selected data plots for the Fox River are also given in figures 2 to 7. Figures 2 to 4 show the temporal variation of selected concentrations for the river reach. The spacial variation of data for the Fox River sites are also shown in figures 5–7 as box plots, which give the full range of data at the Fox River sites, along with quartiles and median values.

References

Edwards, T.K., and Glysson, G.D., 1999, Field methods for measurement of fluvial sediment: U.S. Geological Survey Techniques of Water-Resource Investigations, book 3, chap. C2, 89 p.

Rantz, S.E., and others, 1982, Measurement and computation of streamflow: volume 1, Measurement of stage and discharge, p. 1−284; volume 2, Computation of discharge, p. 285−631: U.S. Geological Survey Water-Supply Paper 2175, 631 p.

Waschbusch, R.J., Olson, D.L., Ellefson, B.R., and Stark, P.A., 2003, Water resources data—Wisconsin, water year 2002: U.S. Geological Survey Water-Data Report WI−02−1, 643 p.

Table 2. Summary of data collected at seven water-quality sites in Green Lake County, Wis., November 2001 through August 2002

[mg/L, milligram per liter; ft^3/s; cubic feet per second; °C; degrees Celsius; µS/cm, microsiemens per centimeter; NTU, nephelometric turbidity units; <, less than; NS, no sample]

	USGS station number	Date	Time	Ammonia nitrogen, (mg/L)	Nitrate plus nitrite nitrogen (mg/L)	Total Kjeldahl nitrogen (mg/L)	Dissolved phosphorus (mg/L)	Total phosphorus (mg/L)	Suspended solids (mg/L)	Fecal coliform colonies/100ml	Suspended sediment (mg/L)	Stream discharge (ft^3/s)	Dissolved oxygen (mg/L)	pH standard units	Conductance (µS/cm)	Water temperature (°C)	Turbidity (NTU)
Fox River above Puckaway lake	04073140	11/02/2001	11:50	0.041	0.773	0.86	0.011	0.048	12	20	16	699	11.6	7.9	412	9.2	7.0
	04073140	01/24/2002	09:15	.089	1.77	.51	.011	.028	NS	10	7	794	12.2	7.7	460	0.5	1.5
	04073140	03/27/2002	14:25	.022	1.34	.83	.017	.037	5	< 10	4	760	NS	8.6	405	4.1	4.3
	04073140	05/07/2002	10:50	.049	.532	1.13	.015	.074	15	10	6	820	10.6	8.7	355	16.8	6
	04073140	06/27/2002	10:55	< .013	.11	1.28	.029	.112	44	20	NS	705	6.6	7.7	346	25.5	3.4
	04073140	08/13/2002	10:45	.015	.024	.81	.019	.072	17	< 10	17	330	6.4	7.9	366	25.1	12.1
Median				**.032**	**.625**	**.84**	**.016**	**.06**	**15**	**10**	**7**	**732**	**10.6**	**7.9**	**386**	**13.0**	**5.2**
Mecan River near Princeton	04073345	6/25/2002	09:40	.067	.09	1.38	.048	.111	30	780	49	260	3.5	7.0	125	24.1	13.0
	04073345	08/08/2002	15:50	.029	1.75	.5	.014	.034	15	140	19	123	9.8	8.2	337	23.6	5.9
Fox River at Princeton	04073365	11/02/2001	15:25	.058	.65	1.27	.009	.083	40	10	40	788	10.7	8.0	389	10.4	38.8
	04073365	01/24/2002	13:00	.067	1.61	.61	.009	.027	NS	< 10	18	773	13.1	8.2	464	1.1	2.7
	04073365	03/27/2002	09:45	.026	1.26	.78	.011	.051	NS	< 10	10	1170	NS	8.4	395	1.9	7.7
	04073365	05/07/2002	15:55	< .013	.291	1.43	.011	.078	31	10	24	1480	10.8	8.6	357	17.0	16.3
	04073365	06/27/2002	14:05	.033	.088	1.3	.033	.1	29	150	NS	1130	6.3	7.2	277	25.8	14.1
	04073365	08/13/2002	12:05	.025	.388	2.32	.018	.16	62	20	124	383	7.5	8.5	312	25.3	61.4
Median				**.03**	**.519**	**1.28**	**.01**	**.08**	**36**	**10**	**24**	**959**	**10.7**	**8.3**	**373**	**13.7**	**15.2**

Table 2. Summary of data collected at seven water-quality sites in Green Lake County, Wis., November 2001 through August 2002—continued

[mg/L, milligram per liter; ft³/s; cubic feet per second; °C; degrees Celsius; µS/cm, microsiemens per centimeter; NTU, nephelometric turbidity units; <, less than; NS, no sample]

	USGS station number	Date	Time	Ammonia nitrogen, (mg/L)	Nitrate plus nitrite nitrogen (mg/L)	Total Kjeldahl nitrogen (mg/L)	Dissolved phosphorus (mg/L)	Total phosphorus (mg/L)	Suspended solids (mg/L)	Fecal coliform colonies/100ml	Suspended sediment (mg/L)	Stream discharge (ft³/s)	Dissolved oxygen (mg/L)	pH standard units	Conductance (µS/cm)	Water temperature (°C)	Turbidity (NTU)
White River near Princeton	04073440	06/25/2002	12:15	.032	.073	1.02	.038	.064	10	190	NS	363	2.4	6.9	157	25.3	2.6
	04073440	08/08/2002	14:20	.027	.901	.4	.011	.027	9	130	10	116	9.9	7.9	334	24.7	2.9
Sucker Creek near Berlin	04073450	06/25/2002	11:25	.07	.06	3.27	.222	.489	143	610	166	25.9	0.2	6.6	154	24.5	6.4
	04073450	08/08/2002	13:25	.034	.97	.46	.032	.044	< 2	70	4	5.75	7.8	7.5	395	22.3	0.4
Puchyan River at Highway J	040734745	06/25/2002	13:35	.053	.4	.76	.048	.088	19	60	NS	109	7.6	8.4	482	27.6	10.6
	040734745	08/08/2002	11:35	.042	.672	.72	.038	.06	11	210	12	38	10.0	8.0	507	23.3	4.9
Fox River at Berlin	04073500	11/02/2001	14:25	.049	.881	.95	.011	.069	32	200	37	1090	10.8	7.8	401	10.0	27.0
	04073500	01/24/2002	13:45	.047	1.73	.45	.011	.026	NS	< 10	24	1330	12.3	7.8	467	0.1	2.9
	04073500	03/27/2002	11:20	.024	1.22	.77	.011	.04	NS	< 10	12	1700	NS	8.2	408	2.1	8.5
	04073500	05/07/2002	13:15	.089	.158	1.06	.011	.055	15	50	10	2370	8.8	8.0	362	16.4	6.4
	04073500	06/27/2002	12:30	.053	.064	1.36	.076	.181	14	140	23	2540	1.6	6.8	261	25.7	9.3
	04073500	08/13/2002	14:30	.023	.47	1.54	.012	.146	66	300	53	626	8.3	8.4	342	25.9	57.6
Median				**.048**	**.676**	**1.00**	**.011**	**.062**	**24**	**95**	**24**	**1515**	**8.8**	**7.9**	**382**	**13.2**	**8.9**

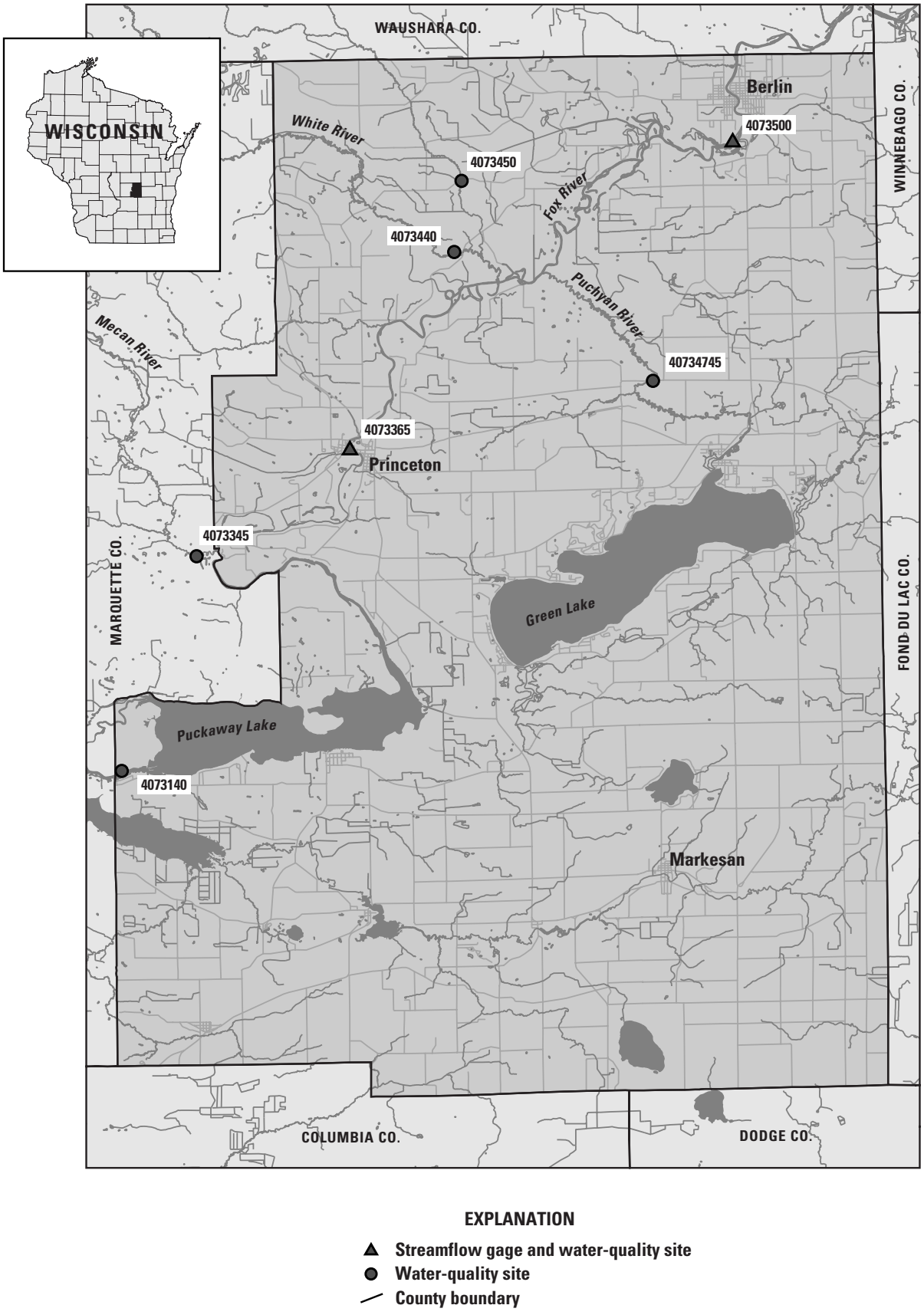

Figure 1. Location of water-quality sampling sites in Green Lake County, Wisconsin.

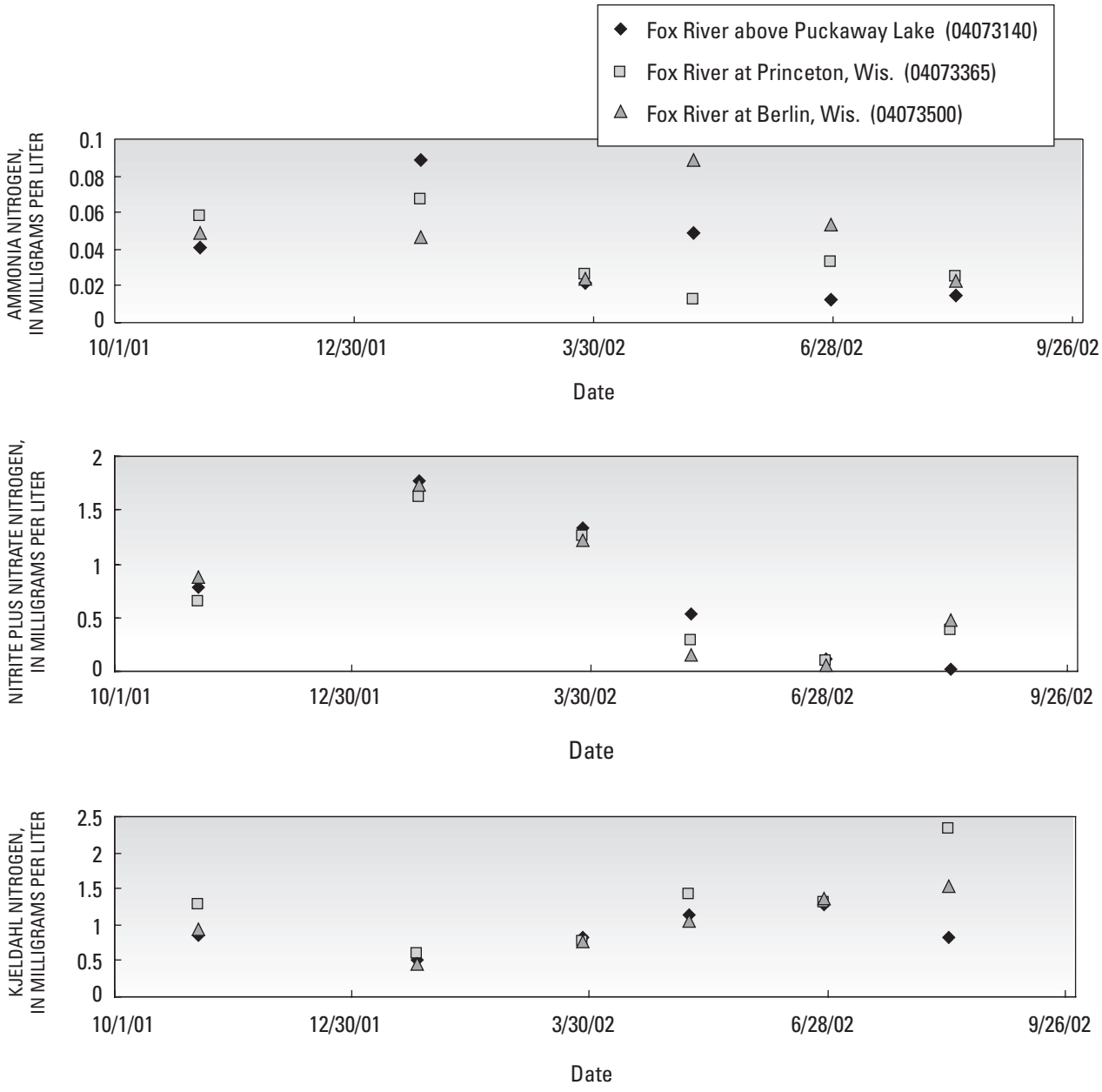

Figure 2. Nitrogen concentrations, November 2001–August 2002 for three Fox River sites.

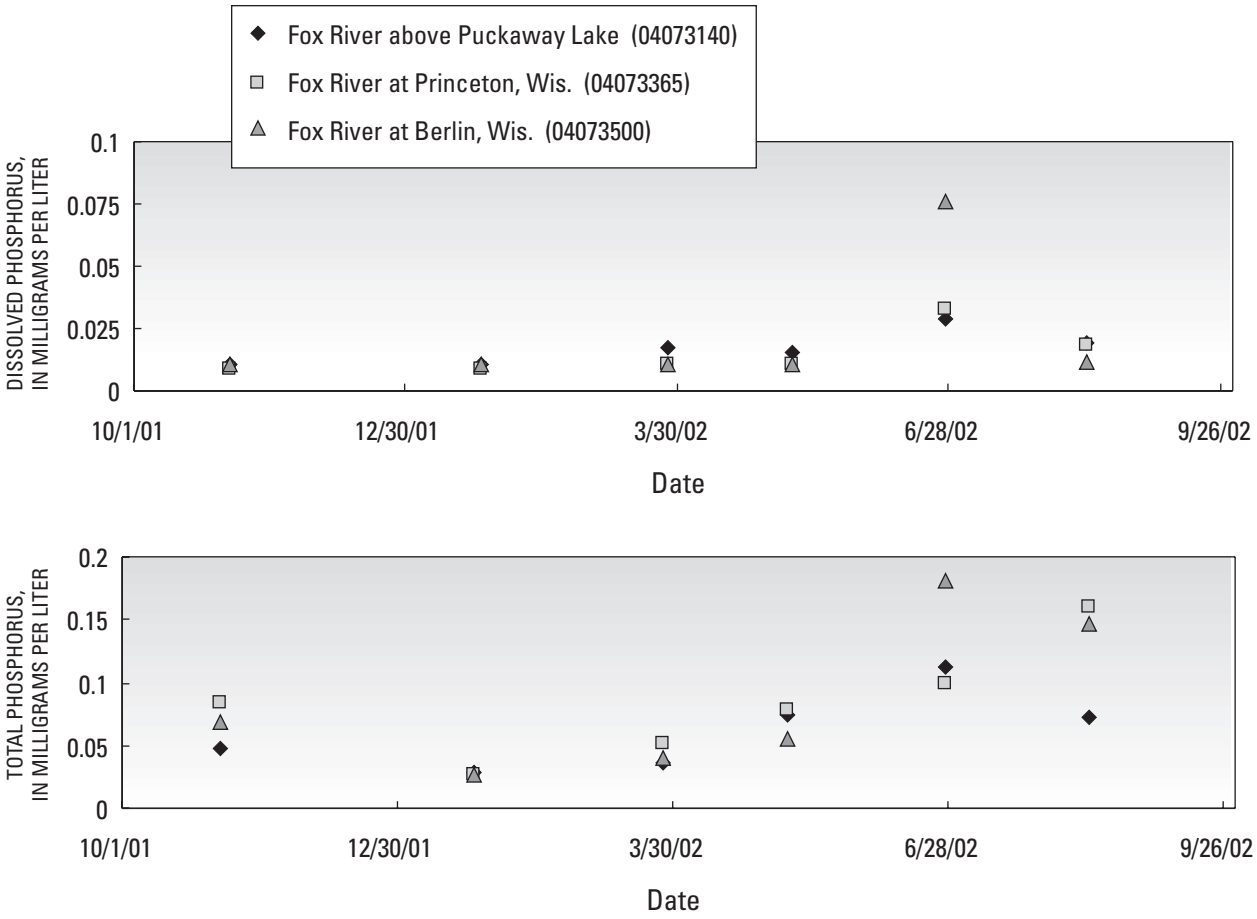

Figure 3. Dissolved and total phosphorus concentrations, November 2001–August 2002 for three Fox River sites.

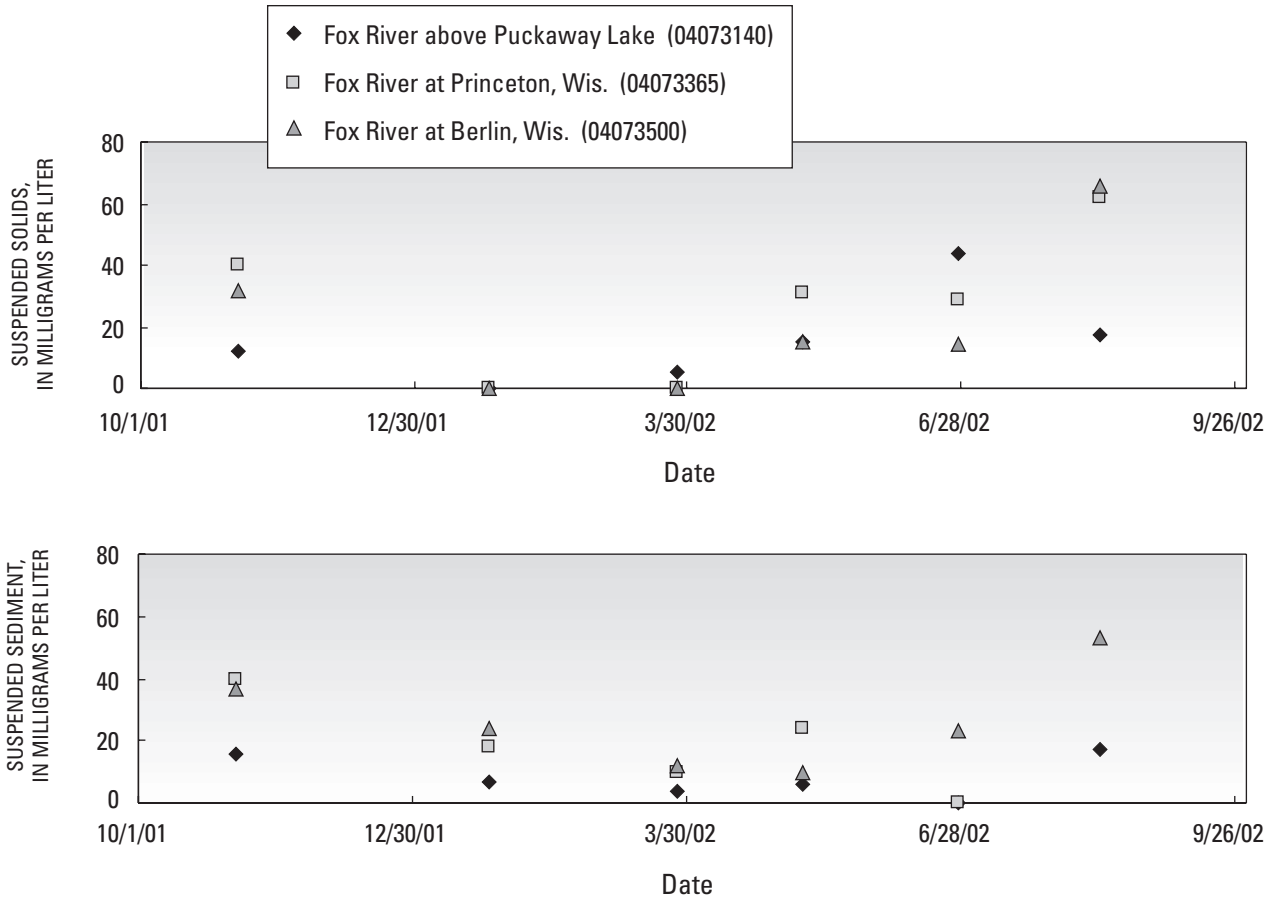

Figure 4. Suspended solids and suspended sediment concentrations, November 2001–August 2002 for three Fox River sites.

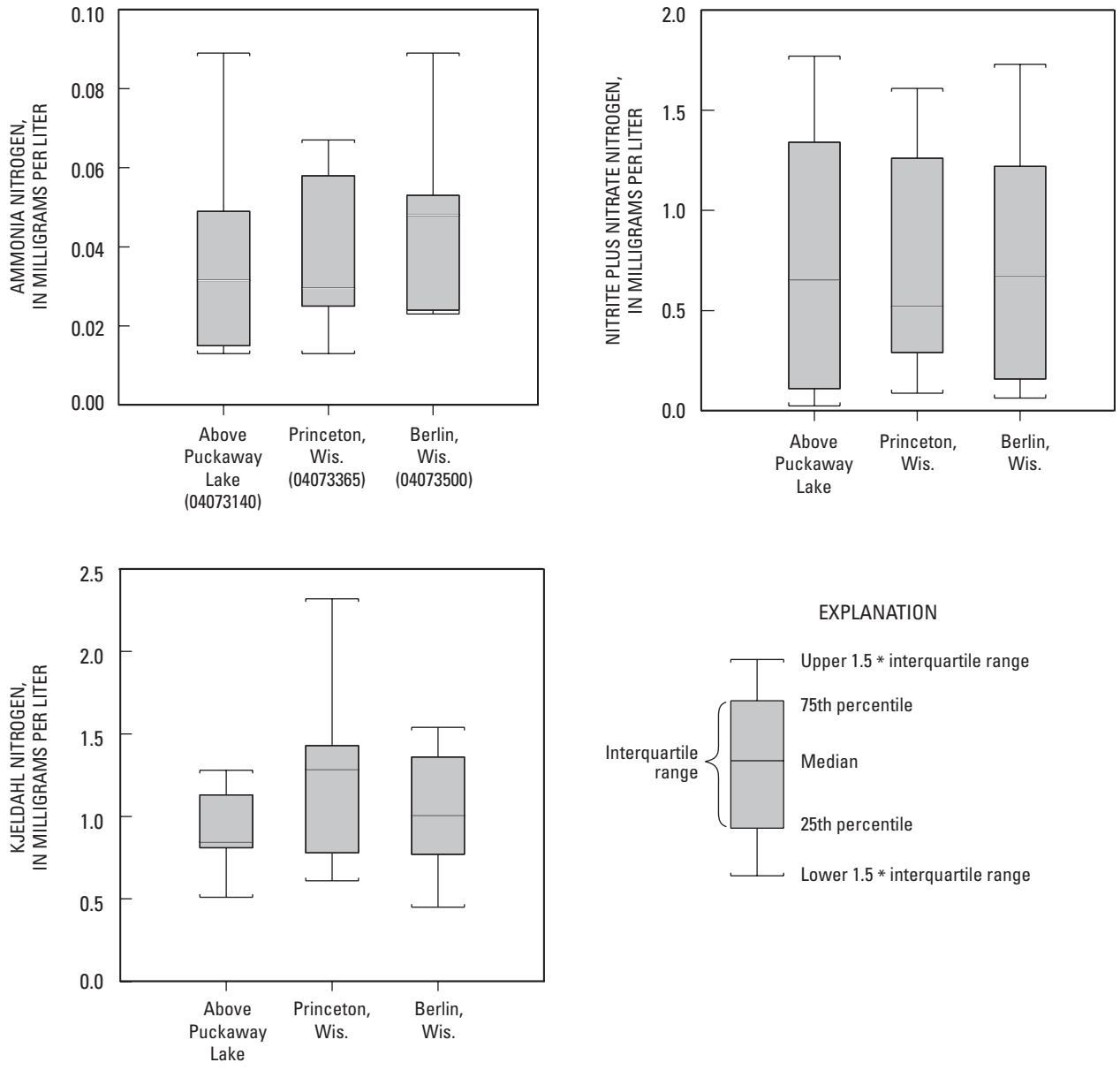

Figure 5. Distribution of nitrogen concentrations for three Fox River sites, November 2001–August 2002.

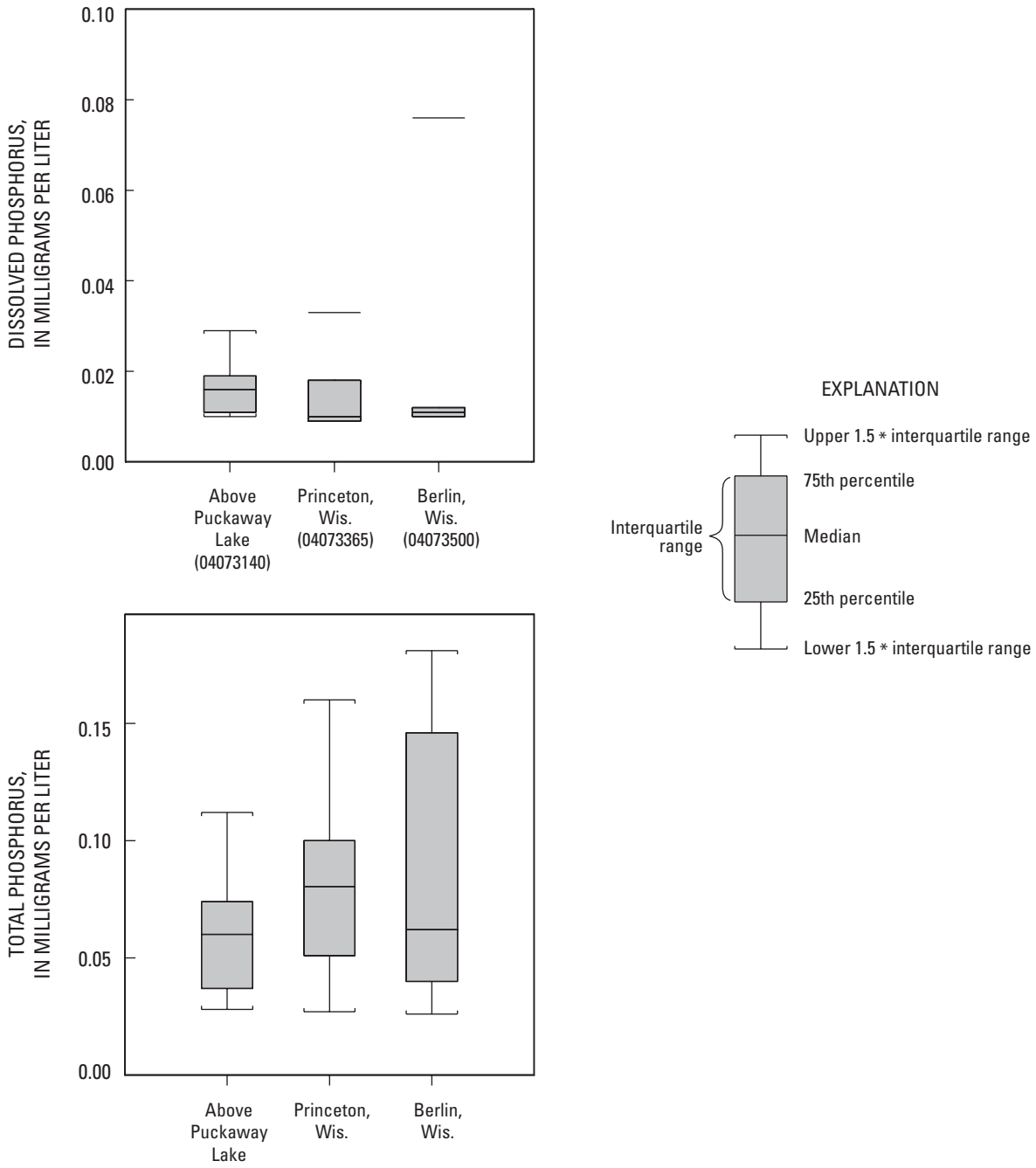

Figure 6. Distribution of total and dissolved phosphorus concentrations for three Fox River sites, November 2001–August 2002.

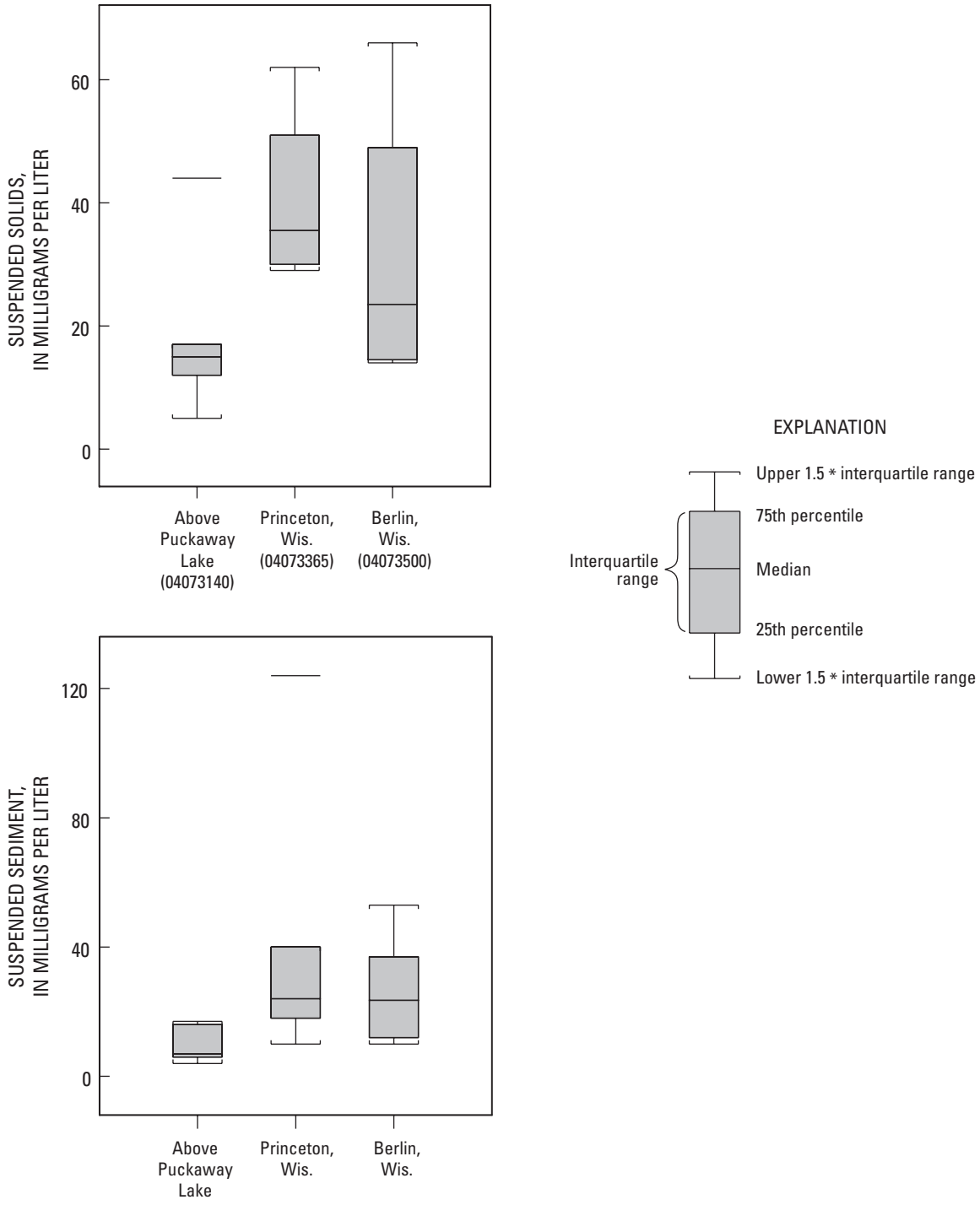

Figure 7. Distribution of suspended solids and suspended sediment for three Fox River sites, November 2001–August 2002.

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